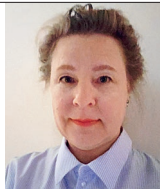


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The ecological resource of an urbanized territory

The urbanization process is accompanied by the growth of cities and an increase in their population. Modern cities are highly complex systems that comprise material and non-material elements of life of urban residents. The development of the urban economy shapes the demand for housing and utility services. Consumer requirements have changed over the years. The aspect of environmental protection and rational use of natural resources from the standpoint of the biosphere approach is to ensure the environmental safety of residential areas in urbanized territories.

The analysis of statistical information and analytical reviews, available in the open-access sources, is carried out in the context of (1) the housing construction in the subjects of the Russian Federation, (2) ensuring the quality of the urban environment in the regions, (3) satisfaction of the local population with the living conditions in a quarter and in a city. The emphasis is placed on the volume and pace of construction of residential apartment buildings in the Russian cities from 2019 to 2021, consumer requirements for apartments, houses, and landscaping.

The ecological resource of an urbanized territory represents the rate and quality of the housing construction, including urban planning, volumetric planning, constructive and technological solutions, as well as the current state of the urban economy, including the volume and quality of housing and utility services provided to the population.

A system of parameters for calculating the ecological resource of residential areas is proposed for discussion, including the estimated indicators of the results of urban planning activities at the stages of the life cycle of a territory and the underground, surface and above-surface facilities that it accommodates. Macro-level design includes the accommodation and construction of permanent construction facilities, linear facilities and their infrastructure; the landscaping of the territory, as an element of the "green" urban framework; a system for handling solid municipal, bulky and hazardous waste. The micro-design is an ecological resource at the level of structural elements of a residential zone, it encompasses a residential area, a micro-district, a block, a complex.

Keywords: *sustainable development, environmental safety, environmental protection, urban planning activities, housing construction, urban economy*

Modern cities are highly complex systems that represent a combination of material and non-material elements of the vital activity conducted by the population [1–3]. Numerous studies, carried out in many countries, including Russia, have assessed the impact of urban development [4, 5] and urban economy on the environment and humans [6–10], since they are focused on the directions of urban development that ensure a high-quality and safe living environment [11–15].

The analysis of the regulatory framework for the environmental design and effective environmental standards in construction, conducted by V.I. Teliachenko, A.A. Benouj, E.A. Sukhinina, shows that the country lacks a mature regulatory and technical framework, whose purpose would be the design of an eco-sustainable architectural and urban planning environment [16].

The task of analyzing and forecasting the ecological resource of urbanized territories in the context of their residential zones remains unsolved and needs a solution in many localities [17].

The co-authors believe that the ecological resource of the natural environment [18] is the value of the maximum cumulative indirect impact on the natural environment, at which its state meets the requirements of environmental standards within the boundaries of the pre-set target ecological zone. In the environment of vital activity, the total impact is calculated using maximum acceptable sanitary and hygienic concentrations [19].

The development of housing and the urban environment is one of Russia's national priorities¹. There, high housing demand is caused by the low average availability of housing for the population. About 40 % of the population needs better housing conditions².

To achieve the target indicator of national development goal "Comfortable and safe living environment", or the commissioning of 120 mln m² of housing annually, it is necessary to increase the volumetric indicators of construction². The area to be occupied by apartment buildings under construction should be about 140 mln m², and the size of annually launched new housing construction projects should increase to 70 mln m²². Hence, the investment and construction phase of an apartment building project takes an average of two to three years, of which the development of design and initial approval documentation take from six months to a year².

The mass construction of multi-storeyed apartment buildings continues to be the main direction of modern urban development in the country [20]. An apartment building (AB) is a set of two or more apartments that have independent exits facing either the land plot adjacent to the residential building or the common areas in such a building³. An AB has

¹ On national goals and strategic objectives for the development of the Russian Federation until 2024 : Decree of the President of the Russian Federation No. 474 of July 21, 2020.

² Overview of housing, housing construction and mortgage markets in 2020. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/e84/e847279b9139afd0ae3f407cd6fb7bf5.pdf>

elements of common property of the owners of premises in such a house in accordance with the housing legislation³.

The Russian Federation has 85 subjects, consolidated into 8 federal districts, which differ in the geographical location, natural and climatic conditions, territory size, population figures, and the level of socio-economic development, which affects the volume of housing construction, demand, and price levels⁴.

As of 01.01.2020, the areas having the largest resident population are the Central and Volga Federal Districts, where 39.4 and 29.2 mln people reside accordingly⁴. The resident population of the Siberian Federal District is 17.1 mln, the number of residents in the Southern Federal District is 16.44 mln, the North-Western Federal District — 13.9 mln, the Ural Federal District — 12.3 mln⁴. Far Eastern and North Caucasian Federal Districts have the smallest resident population numbers with less than 10.0 mln people living in each of them⁴.

As of January 1, 2020, the largest volume of the housing construction was registered in the Central Federal District, it was equal to 38.4 mln m² of AB under construction⁴. The North-Western Federal District has twice as less housing under construction, which reaches 20.0 mln m²⁴. In the Volga and Southern Federal Districts, the volume of the apartment construction is 15.0 and 14.0 mln m². The value of this indicator is below 10 mln m² of housing per each district⁴.

In 2019, the floor area of 6.4 to 13.9 mln m² of new AB was commissioned in each of the Central, Volga, and Northwestern Federal Districts⁴. The volume of AB commissioned in the Far Eastern and North Caucasian Federal Districts is below 1.65 mln m², respectively⁴. The distribution of gross commissioned housing by the districts is largely driven by the population numbers⁴.

The distribution of specific values of the indicator of commissioned housing (per 1,000 people, population), which largely characterizes consumer preferences and development activity in the housing construction market of a federal district, depending on the socio-economic development, geographic and climatic features of its constituent regions, differs from the distribution of absolute values of this indicator⁴.

In the Ural and Northwestern Federal Districts, whose significant parts are located in the north of Russia, the volume of AB construction is 1.5–2.1 times higher than that of individual housing⁴. In other districts, this coefficient varies from 0.7 to 1.2⁴. The highest rate of AB commissioning in 2019 was registered in the North-Western Federal District, it was equal to 459.4 m² per 1,000 people⁴. In the Central and Ural Federal Districts the value reached 351.6 and 330.7 m² per 1,000 people⁴.

As of January 1, 2020, 107.5 mln m² of apartment housing were under construction in the Russian Federation, of which 67.8 % was concentrated in thirteen regions, each of which accounted for, at least, 20 % of the total volume of housing construction in its federal district: Moscow and the Moscow Region — in the Central Federal District, St. Petersburg and the Leningrad Region — in the North-Western Federal District, the Krasnodar Territory and the Rostov Region — in the Southern Federal District,

3 Resolution of the Government of the Russian Federation No. 47 of January 28, 2006: On approval of the Regulations on the recognition of premises as residential premises, residential premises unsuitable for living, an apartment building in emergency and subject to demolition or reconstruction, a garden house as a residential house and a residential house as a garden house.

4 Review of demand and prices on the market of new buildings in the Russian Federation in 2019. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/eb1/eb1a9a29c51163010b0b1969bd9d4ff6.pdf>

the Stavropol Territory — in the North Caucasian Federal District, the Republic of Bashkortostan — in the Volga Federal District, the Sverdlovsk and Tyumen Regions — in the Ural Federal District, the Novosibirsk Region and the Krasnoyarsk Territory — in the Siberian Federal District and the Primorsky Territory — in the Far Eastern Federal District⁴.

All things being equal, current demographic processes have a restraining effect on demand in the housing market.

The pandemic, affecting the country's economy, also affected the construction industry. As a result of the quarantine restrictions in April – May 2020, there was a significant reduction in housing sales². 44 regions out of 85 had restrictions imposed on construction work. In Moscow and the Moscow Region, construction was stopped for almost a month². In addition, due to the closure of the borders, construction sites suffered for workforce shortages². As a result, the commissioning of some construction facilities was postponed, but this postponement was not large-scale all over the country². A set of measures was adopted to support the construction industry in pursuance of the instruction of the President of the Russian Federation. The market conditions, that were favourable for the purchase of real estate, led to the demand implementation. In June, home sales returned to the pre-crisis level, and in July they exceeded it. The area of commissioned housing also approached the values of 2019, and the launch of new projects by developers was growing steadily².

The largest share of mortgage borrowers are citizens under 35 years of age (62 %). In 2020, the record number of mortgages was issued: 1.7 mln loans (+35 % against 2019) worth 4.3 trln rubles (+51 %), of which 484 thousand loans (+42 % against 2019) worth 1.5 trln rubles (+62 %) were issued on the primary market. In the regional context, the largest mortgage amounts were issued in Moscow (14.7 % in terms of the amount, 6.8 % in terms of the number of loans), the Moscow region (8.2 % and 5.5 %, respectively), St. Petersburg (6.6 and 4.8 %), the Tyumen Region (4.4 and 4.2 %) and the Sverdlovsk Region (3.2 and 3.5 %). The largest share of mortgage loans is issued for the purchase of housing in the AB, which accounts for 52 % of commissioned housing².

Despite the pandemic, 1,121.6 thousand apartments with the total area of 82.2 mln m², were commissioned in 2020, which is comparable with the level of 2019: 82.0 mln m². As of January 1, 2021, the volume of apartment housing under construction was 94.0 mln m² in Russia. During the year it went down by 13.5 mln m² (–12.5 %) due to the lack of new projects in the first half of the year against the background of the pandemic and the demand for housing. The volume of AB housing commissioned as of the end of 2020 amounted to 42.4 mln m², 1.16 mln m² (2.7 %) below the level of 2019².

On average, 0.56 m² were built for each resident of Russia in 2020². Per capita housing construction was most intensive in the Leningrad Region (1.41 m²/person), Sevastopol (1.34 m²/person), the Moscow Region (1.17 m²/person), the Kaliningrad Region (1.15 m²/person) and the Lipetsk Region (1.09 m²/person)².

By the end of 2020, there was a shortage of high readiness housing in Russia². As of 01.01.2021, depending on the region, 66–79 % of housing under construction and to be commissioned in 2021 was sold². The share of sold AB housing to be completed in 2022 is 32 %, in 2023 — 14 %, in 2024 — 11 %, in 2022 — 10 %².

As for the price behaviour in the market of new buildings for the 9 months of 2020, the price growth rate in the primary housing market exceeded the average one in Russia (10.4%) in Moscow

- ▶ (16.5 %), the Moscow region (16.4 %), St. Petersburg (13.1 %) and the Kaliningrad region (11.6 %)⁵.

As of the end of May 2021, the area of apartment construction exceeded 1 mln m² in 21 regions, including Moscow, St. Petersburg, the Moscow Region, the Krasnodar Territory, the Republic of Bashkortostan, the Sverdlovsk Region, the Leningrad Region, the Novosibirsk Region, the Rostov Region, the Tyumen Region, the Krasnoyarsk Territory, the Republic of Tatarstan, the Voronezh Region, the Samara Region, the Ryazan Region, the Kaliningrad Region, the Perm Region, the Stavropol Territory, the Udmurt Republic, the Primorsky Territory, the Nizhny Novgorod Region, which account for the 79 % of the apartment housing construction market of the Russian Federation (75.6 mln m²)⁶. The top 3 regions account for 37 % of the apartment housing construction market: 17.2 % in Moscow, 10.4 % in St. Petersburg and 9.8 % in the Moscow region⁶.

Multi-storeyed urban construction is characterized by high population density, intensive use of territories, grave social, environmental, and transport problems [20].

61.7 mln families reside in Russia, of which 64 % live in AB². The key factors that determine the choice of homes are the social infrastructure and transport accessibility, ecology, landscaped curtilage, proximity to the city centre².

A study jointly conducted in Russia in December 2020 by DOM.RF, VTsIOM (The All-Russian Public Opinion Research Centre), that represented a formalized personal interview based on a standardized questionnaire (a sidewalk interview lasting not more than 15 min) among 1.6 thousand respondents aged 18 years, showed that in the conditions of movement restrictions, every family living in AB (37 % of respondents) believed that the most important factor was the proximity of housing to the social infrastructure; and the second important factor was the location of the house next door to a forest area or forest (21 %); transport accessibility was the third important factor (16 %); and the next important factor was the availability of courtyards and playgrounds (15 %)⁷.

As for the urban real estate, new models are in demand [21]. According to the annual sociological survey "Demand for housing and mortgage lending", jointly conducted by DOM.RF and VTsIOM in September 2020, among 5,700 people from 150 settlements located in, at least, 50 subjects of the Russian Federation, the majority of respondents living in the cities with a population of over 1 million people prefer to purchase the following apartments in the AB⁸:

- 15 % of potential buyers choose apartments in buildings having 1–5 floors, 34 % — 6–12 floors, 28 % — more than 12 floors, the number of stories in a building does not matter for 23 % of consumers;
- 6 % of respondents wanted to buy a single-room apartment having the area of 35...50 m², 44 % of respondents wanted to buy a two-room apartment with the area of 45...70 m², 41 % — a two-room apartment with the area of 60...90 m², 9 % of families consider an apartment with four or more rooms and the area of 83...125 m² as the most preferable option.

5 Analytical review: On the dynamics of prices in the market of new buildings for 9 months of 2020. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/724/7246eac18a72d2cc308d6db09d3c121e3.pdf>

6 Overview of multi-family housing construction in the Russian Federation: May 2021. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/558/558f1a545b370dc56a35b75df45aea5a.pdf>

7 Analytical review: The most popular characteristics of housing in 2020. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/765/76500cce2e25af9caeea6c6db6b6dfef.pdf>

8 Analytical review: Characteristics of apartments planned for purchase. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/095/09510ab65b4219a0d6ce14373b5427d6.pdf>

A high-quality residential environment is based on a compact city model. The main criteria include a large selection of housing, safety, environmental friendliness, as well as a variety of functions and mixed development areas, where housing, cultural and social facilities share the same area⁹.

The basic principles of a high-quality residential environment⁹:

- comfort: the balance between the environment and a person, safety;
- diversity: versatility, adaptability;
- sustainability: environmental friendliness, economic feasibility.

Standard housing requirements:

- transparent walk-through entrance lobbies to ensure secure and see-through access to residential areas;
- the entrance to the lobby is at the street level to ensure the accessibility of apartments for all groups of residents;
- the number of elevators in the house ensures fast delivery of residents without queues;
- spaces for air conditioners ensure their easy installation and uniform facades;
- storage areas: storage spaces are on the ground floors;
- the ground floor has a minimal number of load-bearing walls and a pre-set ceiling height;
- the minimal ceiling height in the house is 2.8 m;
- the rooms have convenient shapes to ensure the functional use of the free space.

Ratings, being both a method of scientific analysis and a means for presenting results in a form that is comprehensible by a wide range of people, bind the audience to the information that is presented, which is especially important for the environmental situation [22, 23].

Mechanisms, used to develop comfortable urban environments and integrated urban areas are devised with regard for the urban environment quality index, which is a tool for assessing the quality of the material urban environment and the conditions of its formation¹⁰.

To determine the urban environment quality index, 36 indicators are used that characterize six types of urban spaces: housing, public and business infrastructure, social and leisure infrastructure, landscaping, street infrastructure, public space, which are evaluated using six environment factors: safety, comfort, environmental friendliness, identity and diversity, modern environment, efficiency of government management¹¹.

The quality of the environment is indirectly assessed by the index with the help of the following indicators: the share of solid municipal waste (SMW) delivered for processing and reclamation as part of the total generated and removed SMW; traffic; the share of green public areas in the total area of green spaces; the level of landscaping; the share of green spaces; the share of green spaces accessible by the general public in the total area of green spaces; the share of mechanically cleaned urban areas in the total area of a city¹⁰.

The urban environment quality index, developed by the Ministry of Construction of the Russian Federation together with the

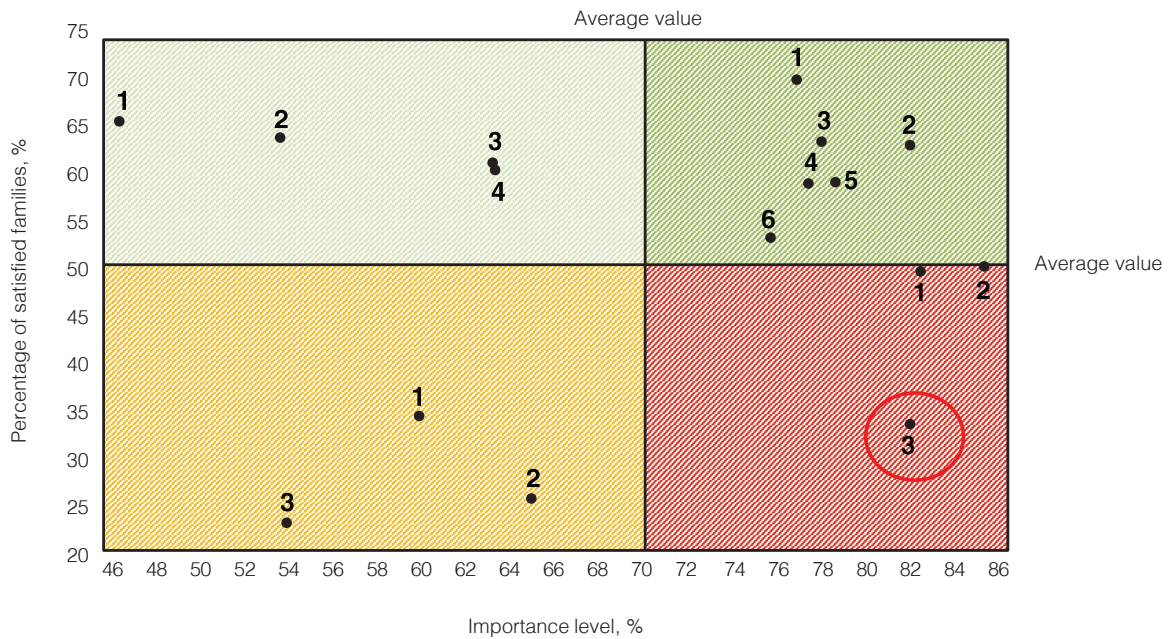
9 DOM.RF. URL: <https://xn--d1aqf.xn--p1ai/urban/standard-housing/>

10 Guidelines for determining the priority directions of urban environment development using the Urban Environment Quality Index. URL: https://minstroyrf.gov.ru/upload/iblock/133/rukovodstvo_index_compressed.pdf

11 Decree of the Government of the Russian Federation No. 510-r of March 23, 2019: On approval of the Methodology for forming the Urban Environment Quality Index.

The urban environment quality index in the regions where the volume of apartment housing construction exceeded 1 mln m² as of June 1, 2021

Subject of the Russian Federation	Federal district	Number of cities	Land area occupied by residential housing as of 2020, thousand hectares	AB construction volume as of June 1, 2021, thousand sq. m	Population, thousand people	Urban Environment Quality Index in 2020				
						Subject of the Russian Federation, score			The largest city in the subject of the Russian Federation	
						minimum	medium	maximum	Name	Index, score
Moscow	Central	1	21.2	16,431	12,678.1	—	—	—	Moscow	288
Saint Petersburg	North-West	1	13.8	9,970	5,398.1	—	—	—	Saint Petersburg	249
Moscow region	Central	73	60.6	9,419	5,600	174	208	263	—	—
Krasnodar Krai	South	26	35.2	7,194	3,000	139	176	225	—	—
Republic of Bashkortostan	Privolzhsky	21	23.7	3,424	2,500	165	184	204	Ufa	189
Sverdlovsk region	Uralsky	47	49.1	3,020	3,500	151	179	216	Ekaterinburg	194
Leningrad region.	North-West	33	13.1	2,838	1,048.2	154	192	259	—	—
Novosibirsk region	Siberian	14	17.3	2,806	2,000	126	152	181	Novosibirsk	166
Rostov region	Yuzhny	23	35.5	2,395	2,800	131	174	222	Rostov-on-Don	200
Tyumen region	Uralsky	District 5	9.9	2,286	1	179	204	225	—	—
Krasnoyarsk Territory	Siberian	23	26.3	2,158	2,000	136	165	214	Krasnoyarsk	181
Republic of Tatarstan	Privolzhsky	24	26.1	2,108	2,900	163	188	216	Kazan	204
Voronezh Region	Central	15	23.1	1,674	1,500	146	179	209	Voronezh	176
Samara region	Privolzhsky	11	22.9	1,471	2,400	147	171	208	Samara	168
Ryazan region	Central	12	13.6	1,439	714.6	149	173	202	—	—
Kaliningrad region	North-West	22	8.8	1,403	780.8	154	191	224	—	—
Perm region	Privolzhsky	25	23.8	1,272	1,900	157	172	197	Perm	179
Stavropol Territory	North Caucasus	Region 19	22.1	1,147	1,500	149	171	208	—	—
Udmurt Republic	Privolzhsky	District 6	9	1,114	992.2	167	175	187	—	—
Primorsky Krai	Far East	12	29.2	1,051	1,300	128	161	186	—	—
Nizhny Novgorod region	Privolzhsky	28	24.7	1,017	2,300	158	183	220	Nizhny Novgorod	201



A high satisfaction/ high importance zone	1	Social infrastructure
	2	Landscaping of city streets
	3	Organization of public transport
	4	Organization and maintenance of public places
	5	Pedestrian friendliness
	6	Courtyard landscaping
A high satisfaction/ low importance zone	1	Public and business infrastructure
	2	Cultural and entertainment institutions
	3	The outer image of a city
	4	Landscaping of embankments
A development zone showing a lower-than-average satisfaction level	1	The quality of cleaning in public areas
	2	Safety and order
	3	Ecological situation in the city
A low significance/ low satisfaction zone	1	Convenient use of personal cars
	2	Accessibility for disabled persons
	3	Arrangement of pet relief areas

Importance and satisfaction with aspects of the urban environment¹²

DOM.RF Development Institute and Strelka Design Bureau, is not a rating, although it serves as a vehicle used by each city to identify and develop its own zones of growth. Cities are only compared within their size and climate groups.

For regions that have exceeded 1 million sq. m. in terms of the volume of AB construction as of June 1, 2021, information is taken from open-access sources about the population and the area occupied by residential development, and values of the index of the urban environment are also provided (Table).

An important indicator of the quality of the residential environment is the level of satisfaction of the population, so to obtain the objective data on the improvement of internal spaces of residential buildings, it is advisable to conduct a sociological research to identify the basic needs of residents [22–24]. The survey among three thousand respondents, permanently residing in a particular

Russian city with a population of more than 1 mln residents, conducted jointly by DOM.RF and VTsIOM in November 2020, revealed that while the importance of this aspect is quite high (82 %) for residents, the share of families satisfied with the ecological situation in the city is 33 % (Fig.)¹².

Residential areas are characterized by the following sanitation and hygiene factors, that contribute to negative trends in public health:

- chemical load, including chemical contamination of drinking water, outer air and soil;

¹² Analytical review: Assessment of the state and changes of the urban environment of Russia in 2020. URL: <https://xn--d1aqf.xn--p1ai/upload/iblock/925/925e20f3d0f556ef2f0d505b8b2c402c.pdf>

- biological load, including biological contamination of drinking water and soil;
- load associated with physical factors, including noise, vibration, ultrasound, infrasound, thermal, ionizing, non-ionizing, and other radiation.

The symbiosis of urban planning activities and urban economy is a key tool for implementing national goals and projects [20, 25].

The environmental resource of residential areas can be calculated, taking account of macro-and micro-design indicators, for the stages of the life cycle of a territory, as well as underground, surface and above-ground facilities located in it.

Whenever a macro-design of a residential area, showcased by a settlement, is to be developed, the ecological resource is provided by:

- positioning and maintenance of capital construction facilities;
- operation and maintenance of linear-type facilities and their infrastructure;
- creation of green areas as elements of the "green" urban framework;
- SMW, large-size and hazardous waste management systems.
- The micro-design at the level of structural elements of a residential area, such as a district, a micro-district, a block, a complex, takes advantage of the following indicators to generate an environmental resource:
 - building density;
 - number of storeys;
 - spatial planning solutions for residential buildings, including the use of "green" materials and technologies [26];
 - structural and technological solutions for residential buildings, including the use of "green" materials and technologies at the stage of construction;
 - apartment floor plans;
 - color schemes of facades, the glazing of loggias and balconies;
 - availability of parking spaces in built-in and built-in/attached parking areas or detached parking lots, as well as in guest parking lots;
 - temporary storage of motor vehicles near children's and sports grounds, recreation areas;
 - availability and maintenance of public transport stops [27];
 - need for and sufficiency of commercial premises, located on the ground floors of residential buildings [28];
 - availability of the necessary facilities in children's and sports grounds, recreation areas;
 - availability of pet relief areas and the necessary facilities, including toilets for animals;
 - availability of engineering networks, systems and equipment and their condition, application of "green" materials and technologies;
 - availability of indoor areas, equipped with containers for separate collection of municipal waste;
 - organization of pedestrian traffic, as well as bicycles, scooters, etc.;
 - lawns, trees and shrubs with a healthy, well-developed crown [29, 30];
 - maintenance and cleaning of territories, including streets, courtyards, etc.

The analysis of statistical data and analytical reviews helped the co-authors to identify that the impact of the pandemic on the pace of housing construction in a number of regions of the country has been overcome. However, it is necessary to increase the volume of construction of apartment buildings and launch new projects to meet the need for better housing. New construction involves the development of vacant territories, renovation, infill construction. Given the low satisfaction of residents with the ecological situation in a city, it is necessary to calculate the ecological resource of residential areas in an urbanized territory, including a comprehensive assessment of the results of macro- and micro-design at different stages of the life cycle of an area and the facilities that it accommodates.

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Экологический ресурс урбанизированной территории

Процесс урбанизации сопровождается ростом городов и увеличением их населения. Современные города представляют собой сверхсложные системы, включая материальные и нематериальные элементы жизнедеятельности населения. Развитие экономики городов формирует спрос у населения на жилье и жилищно-коммунальные услуги. С течением лет требования потребителей меняются. Аспектом охраны окружающей среды и рационального использования природных ресурсов с позиции биосферного подхода является обеспечение экологической безопасности селитебных зон урбанизированных территорий.

Проведен анализ представленных в открытых источниках статистической информации и аналитических обзоров в разрезе жилищного строительства, реализуемого в субъектах Российской Федерации, обеспечения качества городской среды в регионах, удовлетворенности постоянного населения условиями проживания в жилом квартале и в городе. Сделан акцент на объемах и темпах строительства многоквартирных жилых домов в российских городах за период с 2019 по 2021 гг., требованиях потребителей к квартирам, домам, благоустройству.

Экологический ресурс урбанизированной территории формируется темпом и качеством жилищного строительства, в том числе градостроительных, объемно-планировочных, конструктивно-технологических решений, а также текущим состоянием городского хозяйства, включая объем и качество предоставляемых населению жилищно-коммунальных услуг.

К обсуждению предлагается комплекс параметров для расчета экологического ресурса селитебных зон, включающих оценочные индикаторы результатов градостроительной деятельности

на этапах жизненного цикла территории и размещенных на ней подземных, наземных и надземных объектов. Макропроектирование включает размещение и обеспечение объектов капитального строительства, линейных объектов и их инфраструктуры; формирование озеленения территории, как элемента «зеленого» каркаса города; систему обращения с твердыми коммунальными отходами, а также крупногабаритными и опасными отходами. Микропроектирование формирует экологический ресурс на уровне элементов структуры селитебной зоны — жилого района, микрорайона, квартала, комплекса.

Ключевые слова: устойчивое развитие, экологическая безопасность, охрана окружающей среды, градостроительная деятельность, жилищное строительство, городское хозяйство

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